

APPLICATION NOTE 144

DATA FAX COMMANDS

CLASS 1

FOR

CH179X COMPONENTS

5. FAX CLASS 1 COMMANDS

5.1. FAX I/O PROCESSING

The fax I/O interface supports asynchronous serial and parallel interfaces. The interface rate is 19200 bps. The character format is 8 bits data, no parity, and 1 stop bit. Start and stop elements are removed from the transmit data and added to the receive data. Both transmit and receive data are buffered. Flow control using XON/XOFF (DC1/DC3) or RTS/CTS is provided.

Unique control character strings are identified, filtered, or reinserted into the I/O data stream. These control characters and their resultant action are described below.

5.1.1. DTE-to-Modem Transmit Data Stream

| Characters Detected | Action Taken |
|---------------------|---|
| <DLE><data> | Delete <DLE><data>characters. |
| <DLE><ETX> | Recognize as a string terminator and take appropriate action. |
| <DLE><DLE> | Replace with single <DLE> character. |

5.1.2. Modem-to-DTE Receive Data Stream

| Characters Detected | Action Taken |
|---------------------|------------------------------------|
| <DLE> | Insert extra <DLE> ahead of <DLE>. |

The modem also identifies the end of a frame by inserting <DLE><ETX> into the data stream after the FCS bytes.

5.1.3. Fax Mode Selection

Fax class 1 commands are identified in Table 5-1. Fax modes and rates are determined by the AT+F commands as described in Section 5.2.

Table 5-1. Fax Class 1 Commands

| Command | Function |
|-----------------------------|---------------------------------|
| Service Class ID | |
| +FCLASS= | Service Class |
| Fax Class 1 Commands | |
| +FAE=n | Data/Fax Auto Answer |
| +FTS=n | Stop Transmission and Wait |
| +FRS=n | Receive Silence |
| +FTM=n | Transmit Data |
| +FRM=n | Receive Data |
| +FTH=n | Transmit Data with HDLC Framing |
| +FRH=n | Receive Data with HDLC Framing |

5.1.4. Fax Origination

Origination of fax calls is made using the ATD command. Upon completion of the dial function, a calling tone at 1100 Hz is transmitted, with a cadence of 0.5 seconds on and 3 seconds off. The modem automatically enters mode +FRH=3 and sends the CONNECT message to the DTE when FSK flags are detected from the remote.

5.1.5. Fax Answering

Answering of fax calls is identical to answering of data calls with the exception that the modem enters the fax handshaking mode instead of the data handshaking mode after going off-hook. If +FAE=0, the modem, after sending answer tone, automatically enters fax mode (+FTH=3), sends the CONNECT message to the DTE, and starts sending FSK flags. If +FAE=1, the modem determines whether the caller is a data modem or a fax modem and sends the DATA or FAX result code, respectively, to the DTE.

5.1.6. Fax Control Transmission

Fax control transmission is initiated by the +FTH=n command. After this command is issued, the modem generates the CONNECT message and transmits carrier in the modulation scheme specified by the parameter n. The modem then transmits HDLC flags for a minimum of 1 second. The modem continues to transmit the HDLC flags until it receives a character from the DTE.

When characters are received from the DTE, the modem adds start and end flags, performs zero-bit insertion, generates FCS, and deletes <DLE><chr> character pairs before transmitting the characters to the remote fax machine. Each <DLE><DLE> sequence is transmitted as a single <DLE>. <DLE><EXT> is considered as the end of frame marker and is not transmitted. All data received from the DTE after <DLE><ETX> is ignored by the modem until the modem generates either the CONNECT, OK or ERROR result code.

If no more data is in the transmit buffer and the final bit was a 1 (bit 4 of the second byte received from the DTE), the modem generates the OK result code and returns to the command mode. If the final bit was a 0, the modem generates the CONNECT message and waits for further data from the DTE while transmitting HDLC flags. If no more data is received before 5 seconds elapse, the modem drops carrier, goes on-hook, and generates the ERROR result code.

5.1.7. Fax Control Reception

Fax control reception is initiated using the AT+FRH=n command. After this command is issued, the modem looks for carrier in the modulation scheme specified by the parameter n. If no carrier is detected before the period of time specified by register S7 expires, the modem generates the NO CARRIER message and returns to command mode. If a carrier is detected that is not the one specified by the parameter n, the modem generates the +FCERROR message and returns to the command mode. If the specified carrier is detected, the modem generates the CONNECT message and enters the HDLC receive mode.

In HDLC receive mode, the modem receives HDLC frames from the remote fax machine, strips the flags, performs zero-bit deletion, performs error checking, and handles <DLE><chr> character pairs before passing the data to the DTE. The modem prefixes each <DLE> character with another <DLE> character before sending it to the DTE. After the last byte in the frame, the modem sends <DLE><ETX> to the DTE marking the end of the frame. The modem then generates either the OK message if no errors were detected or the ERROR message if errors were detected (FCS is incorrect), and returns to command mode.

While in command mode, the modem continues to receive data in the selected modulation scheme, and sends the data after sending CONNECT message to the DTE when the DTE reissues the +FRH command with the same parameter. If the DTE issues the +FRH command with a different parameter, the modem clears all buffers and proceeds as described previously.

If carrier is lost while in command mode and the DTE reissues the +FRH command with the same parameter, and there is no data in the buffer, the modem sends the ERROR result code to the DTE and returns to the command mode. If there is data in the buffer, the modem sends the next frame of buffered data to the DTE, followed by <DLE><ETX>, and either the ERROR result code if errors were detected or the OK result code if no errors were detected. The modem then returns to command mode. All subsequent data received from the remote is discarded.

If the modem detects a frame abort sequence (seven consecutive ones with no zero insertion) while it is waiting for a frame beginning flag (it was receiving HDLC flags), it will wait for the HDLC flags again until either carrier is lost, or the DTE aborts the process by sending an abort character or by dropping DTR with &D2 in effect. If the frame abort sequence is detected while the modem is receiving a frame it finishes delivering the data in the receive buffer (if any) to the DTE, sends <DLE><ETX>, generates the ERROR message, and returns to command mode. The modem keeps looking for HDLC flags followed by more data from the remote, with the selected modulation scheme.

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If the modem detects a receive buffer overflow condition, it concludes that there was an FCS error in that frame. The modem will receive more frames only if a starting flag is detected and there is room in the receiver buffer. If a starting flag is detected and there is no room in the buffer, the modem discards all data in that frame.

If the modem receives any character from the DTE after the +FRH command (except flow control characters if software flow control is in effect), or if the modem detects a high-to-low transition of the DTR signal while &D1 is in effect, it sends <DLE><EXT> to the DTE, generates OK result code, and returns to command mode. The receive buffer is cleared and all data received from the remote is discarded. If the modem detects a DTR drop while &D2 is in effect, it goes on-hook, sends <DLE><EXT> to the DTE, generates OK result code, and returns to command mode. If the modem detects a DTR drop while &D3 is in effect, the modem performs a warm reset.

5.1.8. Fax Data Transmission

Fax data transmission is initiated by the AT+FTM=n command. After this command is issued, the modem generates the CONNECT message and transmits carrier in the modulation scheme specified by the parameter n. The modem then transmits constant 1 bits for a minimum of one second and continues to transmit constant 1 bits until it receives a character from the DTE.

When data is received from the DTE, the modem deletes start and stop bits and deletes all <DLE><chr> character pairs before transmitting the data to the remote. Each <DLE><DLE> sequence is transmitted as a single <DLE>. <DLE><ETX> is considered as the end of a stream marker, and is not transmitted. All data received from the DTE after the <DLE><EXT> is ignored by the modem until the modem generates either the CONNECT, OK or ERROR result code.

If no more data is in the transmit buffer, and the last transmitted character was not an ASCII NULL, the modem generates the connect message to the DTE and waits for further data from the DTE while transmitting NULLs to the remote. If more data is received before five seconds elapse, the modem continues to transmit the data as described in the previous paragraph. If five seconds elapse and no data is received from the DTE, the modem drops carrier, goes on-hook, and generates the ERROR result code.

5.1.9. Fax Data Reception

Fax data reception is initiated using the AT+FRM=n command. After this command is issued, the modem looks for carrier in the modulation scheme specified by the parameter n. If no carrier is detected before the period of time specified by register S7 expires, the modem generates the NO CARRIER message and returns to command mode. If a V.21 carrier is detected when a high speed carrier is expected, the modem generates the +FCERROF message and returns to the command mode. If the specified carrier is detected, the modem generates the CONNECT message and enters the data receive mode.

While in data receive mode, the modem receives data from the remote, adds start and stop bits, and handles <DLE><chr> character pairs before passing the data to the DTE. The modem prefixes each <DLE> character with another <DLE> character before sending it to the DTE.

If carrier is lost for a time period longer than the time specified by the register S10, the modem finishes delivering the data in the receive buffer (if any) to the DTE, sends <DLE><ETX>, generates the NO CARRIER result code, and returns to the command mode. All subsequent data received from the remote is discarded.

If the modem detects a receive buffer overflow condition, it stops receiving from the remote until there is room in the receive buffer. The modem informs the DTE of the buffer overflow after it sends to the DTE the last character that was stored in the buffer before the overflow occurred.

If the modem receives any character from the DTE after the +FRM command (except flow control characters if software flow control is in effect), or if the modem detects a high-to-low transition of the DTR signal while &D1 is in effect, it sends <DLE><ETX> to the DTE, generates the OK result code, and returns to command mode. The receive buffer is cleared and all data received from the remote is discarded. If loss of DTR is detected while &D2 is in effect, the modem goes on-hook, sends <DLE><ETX> followed by OK result code to the DTE, and returns to command mode. If the modem detects a DTR drop while &D3 is in effect, the modem performs a warm reset.

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5.2 COMMANDS

+FCLASS=n - Select Service Class

+FCLASS=n command sets the active service class.

Parameters: 0-2

Command options:

| | |
|-----------|-----------------------------|
| +FCLASS=0 | Select Data Mode (Default.) |
| +FCLASS=1 | Select Facsimile Class 1 |
| +FCLASS=2 | Select Facsimile Class 2 |

+F<command>=? - Report Active Configuration

+F<command>=? interrogates the modem to determine the active configuration.

Typical responses are:

| | |
|-----------|---|
| +FAE=? | 0 if auto answer is disabled; 1 if auto answer is enabled |
| +FCLASS=? | 0 if in data mode; 1 if in fax class 1; 2 if in fax class 2 |

+F<command>? - Report Operation Capabilities

+F<command>=? can be used to determine the operating capabilities of the modem.

Typical responses are:

| | |
|-----------|--|
| +FAE=? | 0 or 1 |
| +FCLASS=? | 0, 1, or 2 |
| +FTM=? | 24, 48, 72, 73, 74, 96, 97, 98, 121, 122, 145, 146 |
| +FRM=? | 24, 48, 72, 73, 74, 96, 97, 98, 121, 122, 145, 146 |

+FAE=n - Data/Fax Auto Answer

+FAE=n allows the DTE to either restrict answering to class 1, or to automatically detect whether the calling station is a fax class 1 modem or data modem, and answer accordingly.

Parameters: n = 0 or 1

Command Options:

| | |
|-----|--|
| n=0 | Disable data/fax auto answer mode. The modem answers as a fax modem only. (Default.) |
| n=1 | Enable data/fax auto answer mode. The modem answers as a fax or data modem. |

After a data (not fax) connection is achieved (indicated by the DATA result code), the DTE must issue an ATO command to cause the modem to go on-line.

+FTS=n - Stop Transmission and Wait

+FTS=n causes the modem to terminate a transmission and wait for n 10-ms intervals before responding with the OK result code. An ERROR response code results if this command is issued while the modem is on-hook.

+FRS=n - Receive Silence

+FRS=n causes the modem to report back to the DTE with an OK result code after n 10 ms-intervals of silence have been detected on the line. This command is aborted if any character is received from the DTE. The modem discards the aborting character and issues an OK result code. An ERROR response code results if this command is issued while the modem is on-hook.

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+FTM=n - Transmit Data

+FTM=n causes the modem to transmit data using the modulation defined below. An ERROR response code results if this command is issued while the modem is on-hook.

Parameters: See Command options
Command options:

| | |
|----------|----------------------|
| +FTM=24 | V.27 ter 2400 bps |
| +FTM=48 | V.27 ter 4800 bps |
| +FTM=72 | V.29 7200 bps |
| +FTM=73 | V.17 7200 bps long |
| +FTM=74 | V.17 7200 bps short |
| +FTM=96 | V.29 9600 bps |
| +FTM=97 | V.17 9600 bps long |
| +FTM=98 | V.17 9600 bps short |
| +FTM=121 | V.17 12000 bps long |
| +FTM=122 | V.17 12100 bps short |
| +FTM=145 | V.17 14400 bps long |
| +FTM=146 | V.17 14400 bps short |

+FRM=n - Receive data

+FRM=n causes the modem to enter the receiver mode using the modulation defined below. An ERROR response code results if this command is issued while the modem is on-hook.

Parameters: See command Options
Command Options:

| | |
|----------|----------------------|
| +FRM=24 | V.27 ter 2400 bps |
| +FRM=48 | V.27 ter 4800 bps |
| +FRM=72 | V.29 7200 bps |
| +FRM=73 | V.17 7200 bps long |
| +FRM=74 | V.17 7200 bps short |
| +FRM=96 | V.29 9600 bps |
| +FRM=97 | V.17 9600 bps long |
| +FRM=98 | V.17 9600 bps short |
| +FRM=121 | V.17 12000 bps long |
| +FRM=122 | V.17 12000 bps short |
| +FRM=145 | V.17 14400 bps long |
| +FRM=146 | V.17 14400 bps short |

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+FTH=n - Transmit Data with HDLC Framing

+FTH=n causes the modem to transmit data using HDLC protocol and the modulation defined below. An Error response code results if this command is issued while the modem is on-hook.

Parameters: See Command Options:

Command Options:

| | |
|----------|------------------------|
| +FTH=3 | V.21 channel 2 300 bps |
| +FTH=24 | V.27 ter 2400 bps |
| +FTH=48 | V.27 ter 4800 bps |
| +FTH=72 | V.29 7200 bps |
| +FTH=73 | V.17 7200 bps long |
| +FTH=74 | V.17 7200 bps short |
| +FTH=96 | V.29 9600 bps |
| +FTH=97 | V.17 9600 bps long |
| +FTH=98 | V.17 9600 bps short |
| +FTH=121 | V.17 12000 bps long |
| +FTH=122 | V.17 12000 bps short |
| +FTH=145 | V.17 14400 bps long |
| +FTH=146 | V.17 14000 bps short |

+FRH=n - Receive Data with HDLC Framing

+FRH=n causes the modem to receive frames using HDLC protocol and the modulation defined below. An ERROR response code results if this command is issued while the modem is on-hook.

Parameters: See Command Options.

Command Options:

| | |
|----------|------------------------|
| +FRH=3 | V.21 channel 2 300 bps |
| +FRH=24 | V.27 ter 2400 bps |
| +FRH=48 | V.27 ter 4800 bps |
| +FRH=72 | V.29 7200 bps |
| +FRH=73 | V.17 7200 bps long |
| +FRH=74 | V.17 7200 bps short |
| +FRH=96 | V.29 9600 bps |
| +FRH=97 | V.17 9600 bps long |
| +FRH=98 | V.17 9600 bps short |
| +FRH=121 | V.17 12000 bps long |
| +FRH=122 | V.17 12000 bps short |
| +FRH=145 | V.17 14400 bps long |
| +FRH=146 | V.17 14400 bps short |

5.3 EXAMPLES

Examples of calling (transmitting) and answering (receiving) one page using fax class 1 commands are shown in Tables 5-2 and 5-3, respectively.

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Table 5-2. Fax Class 1 Calling Sequence (One page)

| DTE Commands (Host) | DCE Responses (Modem) | Remote Fax | Notes |
|---------------------------------|--|--|---------------------------|
| (1) AT+FCLASS=1 | (2) OK | | Set to Class 1 |
| PHASE A | | | |
| (3) ATDT6163 | (4) Dials (6) CONNECT | (5) Answers (7) Send HDLC flags | +FRH=3 implied by dialing |
| PHASE B | | | |
| | | (8) | Sends NSF frame |
| (10) AT+FRH=3 | (9) <NSF>, OK (11) CONNECT | | |
| (14) AT+FRH=3 | (13) <CSI>, OK (15) CONNECT | (12) Sends CSI frame | |
| (19) AT+FTH=3 | (17) <DIS>, OK (20) Send HDLC flags (21) CONNECT | (16) Send DIS frame (18) Drop carrier (21) Receive flags | Last frame bit = 1 |
| (22) <TSI> | (23) Send TSI frame (25) CONNECT | (24) Receive TSI | Last frame bit = 0 |
| (26) <DCS> | (27) Send DCS frame (29) Detect last frame bit (39) OK, drop carrier | (28) Receive DCS | Last frame bit = 1 |
| (31) AT+FTS=8 (33) AT+FTM=96 | (32) OK, wait 80 ms (34) Send V.29 (35) CONNECT | | |
| (36) <TCF> | (37) Send TCF data (39) OK | (38) Receive & check | |
| (40) AT+FRH=3 | (41) CONNECT (42) Send CFR frame | | |
| (43) <CFR>, OK | (44) Drop carrier (45) OK | | |
| PHASE C | | | |
| (46) AT+FTM=96 | (47) Send V.29 (48) CONNECT | | |
| (49) age data | (50) Send page data (52) OK | (51) Receive data | |
| (53) AT+FTH=3 | (54) Send HDLC flags (56) CONNECT | (55) Receive flags | |
| PHASE D | | | |
| (57) <EOP> | (58) Send EOP frame (60) OK, drop carrier | (59) Receive EOP | Last frame bit = 1 |
| (61) AT+FRH=3 | (62) CONNECT | | |
| (65) AT+FTH=3 | (64) <MCF>, OK (66) Send HDLC flags (68) CONNECT | (63) Send MCF frame (67) Receive flags | Last frame bit = 1 |
| (69) <DCN> | (70) Send DCN frame (72) OK, drop carrier | (71) Receive DCN | Last frame bit = 1 |
| PHASE E | | | |
| (73) ATH0 | (74) OK, hang-up | (75) Hang up | |

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Table 5-3. Fax Class 1 Answering Sequence (One Page)

| DTE Commands (Host0) | DCE Responses (Modem) | Remote Fax | Notes |
|-----------------------------|---|--|--|
| (1) AT+FCLASS=1 | (2) OK | | Set to Class 1 |
| PHASE A | | | |
| (5) ATA | (4) RING (6) Modem answers (7) Send HDLC flags (9) CONNECT | (3) FAX machine, dials (8) Receive flags | +FTH=3 implied by answering |
| PHASE B | | | |
| (10) <NSF> | (11) Send NSF frame | (12) Receive NSF | Last frame bit = 0 |
| (14) <CSI> | (13) CONNECT (15) Send CSI frame (17) CONNECT | (16) Receive CSI | Last frame bit = 0 |
| (18) <DIS> | (19) Send DIS frame (21) OK, drop carrier | (20) Receive DIS | Last frame bit = 1 |
| (22) AT+FRH=3 | (23) CONNECT | | |
| (26) AT+FRH=3 | (25) <TSI>, OK (27) CONNECT | (24) Send TSI frame | Last frame bit = 0 |
| (31) AT+FRH=3 | (29) <DCS>, OK | (28) Send DCS frame (30) Drop Carrier | Last frame bit = 1 |
| (38) AT+FTH=3 (40) <CFR> | (33) CONNECT (35) <TCF> (37) NO CARRIER (39) CONNECT (41) Send CFR frame (43) NO CARRIER | (32) Send V.29 (34) Send TCF Frame (36) Drop carrier (42) Receive CFR | Last frame bit = 1 |
| PHASE C | | | |
| (44) AT+FRM=96 | (46) <page data> (48) NO CARRIER | (45) Send page data (47) Drop carrier | |
| PHASE D | | | |
| (49) AT+FRH=3 | (50) CONNECT | | |
| (53) AT+FTH=3 (55) <MCF> | (52) <EOP>, OK (54) CONNECT (56) Send MCF frame (58) OK, drop carrier (60) CONNECT | (51) Send EOP frame (57) Receive MCF | Last frame bit = 1 Last frame bit = 1 |
| (59) AT+FRH=3 | (62) <DCN>, OK | (61) Send DCN frame | Last frame bit = 1 |
| PHASE E | | | |
| (73) ATH0 | (74) OK, hang up | (75) Hang up | |